

THE TREATMENT OF DISLOCATION OF THE SHOULDER-JOINT COMPLICATED BY FRACTURE OF THE UPPER EXTREMITY OF THE HUMERUS,

WITH AN ANALYSIS OF SIXTY-THREE CASES WITH FRACTURE AT THE NECK OF THE HUMERUS AND TWENTY-ONE CASES WITH FRACTURE OF THE GREATER TUBEROSITY REPORTED SINCE 1894.*

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My attention has been particularly directed to the above class of injuries by a case of double dislocation of the shoulders with fracture of the surgical neck of the right humerus, which came under my care in November, 1906. The history of the case is as follows:

K. S., white male, aged 35, was knocked from an ice wagon by a street car and sustained injuries to both shoulders and severe contusions of the left leg. The accident happened about 9 A.M. Nov. 11, 1906, and I saw him at St. Vincent's Hospital about an hour later.

It was evident from the deformity that he had sustained dislocations of both shoulders. He was anesthetized for further examination and for reduction of the dislocations. The left shoulder was treated first, and was easily reduced by the Kocher method. On examining the right shoulder crepitus was at once elicited, and it was found that there was a fracture very high up, as well as a dislocation. Both dislocations were of the sub-coracoid variety.

Attempts were made to reduce the dislocations but they were unsuccessful. The patient was allowed to recover from the influence of the anæsthetic, the nature of the injury was explained to him and his permission was secured to perform arthrotony for reduction of the dislocation if we found that this should be

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FIG. 1.



Dislocation of shoulder complicated by fracture of surgical neck of humerus. Seven weeks after operation.

FIG. 2.



Dislocation of both shoulders, with fracture of surgical neck of right humerus.
Thirteen months after operation.

FIG. 3.



Dislocation of both shoulders with fracture of surgical neck of right humerus. Thirteen months after operation.

FIG. 4.



Dislocation of both shoulders with fracture of surgical neck of right humerus. Thirteen months after operation.

FIG. 5.



Dislocation of both shoulders, with fracture of surgical neck of right humerus.
Thirteen months after operation.

Uor 8

necessary. After consultation, he was again anæsthetized, six hours after the injury, and further unsuccessful attempts were made to reduce. These consisted principally in making gentle traction and abduction, together with direct pressure on the head. The joint was then exposed by the anterior incision. The head was found displaced under the coracoid, and a transverse fracture of the humerus was found at the surgical neck with a long splinter torn from the shaft and attached to the upper fragment. The capsule was torn on its anterior aspect. The upper fragment was grasped with lion-jawed forceps but no change in its position could be made. A periosteal elevator was then used and the head was pried into position with but little difficulty.

Before effecting reduction the coracohumeral ligament had to be divided for a few centimetres.

A hole was drilled through the centre of the lower fragment of the humerus, near the line of fracture and a silver wire was passed through this and tied on the outer side of the bone, thereby binding the splintered portion of the fracture to the shaft. There was very little tendency to displacement of the fracture in an inward direction on account of the presence of a periosteal band which connected the two fragments.

The divided coracohumeral ligament and the rent in the capsule were closed with catgut, and a small gauze drain was carried down to the point of fracture. This drain did not communicate with the joint cavity, as this had been completely closed. The drain was removed in a few days and the wound healed by first intention. For four weeks the arm was kept on an internal angular splint with a shoulder cap.

At the time of the injury, the X-ray machine at the hospital was not in working order, so no pictures were obtained before the operation. A picture taken seven weeks after operation shows a good anatomical result, and the functional result is perfect. There is no restriction of movement in any direction. There is neither atrophy, pain, nor weakness in the arm. The accompanying photographs taken Dec. 1, 1907, give an opportunity of comparing in this patient the results of arthrotomy and reduction of the fracture-dislocation on the right side, with that obtained in reduction by the Kocher method of a simple uncomplicated dislocation on the left side. The movements in each shoulder are as free as they were before the injury, and he has been doing for

the past eight months exactly the same work in which he was engaged when he was injured,—delivering ice from a wholesale wagon, and handling 100 pound ice blocks daily.

The presentation of this subject in most of our surgical text-books is not made, upon the whole, in a manner befitting its gravity and importance. There are, however, notable exceptions. Before the appearance in 1894 of McBurney's paper describing the use of his hook, very little had been accomplished in the way of successful treatment of these injuries. Too great stress was laid upon efforts to reduce by manipulation, and McBurney cites 6 cases where death resulted from the violent and persistent efforts which were resorted to in attempting to bring about reduction.

Numerous cases are recorded where fracture of the neck of the humerus has occurred in attempting reduction of difficult shoulder dislocations.

The older methods of treating fracture-dislocation of the shoulder consisted of:

1. Reduction by manipulation. This should still be practiced with gentleness.

2. Securing union in the fracture and then attempting to reduce the dislocation by manipulation, using the re-united shaft of the humerus as a lever. Oger, cited by McBurney, collected all cases treated in this manner up to 1894, 10 in number, with 7 absolute failures and 3 doubtful successes.⁶⁰ In the series of cases herewith presented, one case was so treated, and refracture of the humerus occurred. The method has nothing to commend it, and should be mentioned only to be condemned.

3. The Riberi method. This consisted in making early passive motion with the object of making a false joint at the point of fracture and leaving the dislocation untreated. This method is unworthy of consideration at the present time.

4. Resection. At one time this was offered as an operation of election, and is still in many cases, especially those of long standing, the best thing possible. However, as an opera-

tive procedure, it should be made use of only when reposition cannot be accomplished.

At the present time it is conceded that the best way in which to proceed is to first secure reduction of the dislocation, and then to direct attention to treatment of the fracture.

ARTHROTOMY.

Failing in reasonable attempts to secure reduction of the dislocation by manipulation, sufficient evidence is now at hand to justify us in claiming that immediate arthrotomy with reduction of the dislocation, with or without the use of hooks, followed by suture or reduction and immobilization of fracture, is the ideal method of dealing with this class of cases.

In 1859 Gross wrote, "I should not hesitate if a case of the kind should present itself to me, to cut down upon the dislocated bone and push it back into its normal position."⁶⁴

Stemen, in 1870, first put this plan into successful operation. In one of our very latest systems of surgery, however, we note "an anæsthetic should always be administered and every method should be tried in order to reduce the head before an operation is attempted."⁶⁰ This, to say the least, certainly puts operation on the defensive.

Scudder advises operation in case manipulation fails, and says, "if operative interference has been decided upon it is best to defer operation until acute symptoms have subsided and the damaged tissues have recovered themselves."⁶¹ To this I do not entirely subscribe, for if this teaching is followed, it will eliminate immediate operation, which, from reported cases, has given the best results. He advises McBurney's operation, with use of his hook.

Stimson advocates gentle traction with direct pressure on the head before adopting other measures, and next advises McBurney's operation.⁶² Concerning time he says "I do not condemn the early operation or primary excision when indicated, but I here warn against the tardy early operation, cutting into swollen discolored tissues about severe injuries after the second day."⁶³

Schoch states that arthrotomy is favored by Vamossy, Nicoladoni, Keuster, Albert, Socin, Trendelenburg, Rose, Schoenborn, Nélaton, von Bergmann, and other European surgeons.³⁴ A large number of the highest surgical authorities in this country also favor it.

In a review of fractures and dislocations in the December (1907) *Progressive Medicine*, Bloodgood says, "when fracture is associated with dislocation of a fragment including a portion of the head, open incision should be employed if perfect reduction cannot be made." Quoting Schlange on irreducible fractures and dislocations he says, "as to dislocations there can be no question—every irreducible dislocation should be subjected to immediate open incision and reduction. The time to operate is at once. The changes that will take place in the joint and its surroundings by delay may be irreparable. There should be no old dislocations."³⁵

This subject should be presented to every surgeon and to every general practitioner in such a light that he may realize the value of time in the prognosis of his cases. Many of these cases come first into the hands of the general practitioner, and the history of nearly all the cases classed as "old" is that they received some sort of palliative treatment, or the real nature of the injury was undiscovered until a varying time had elapsed. Every practitioner should realize the gravity of any sort of fracture-dislocation or irreducible dislocation of the shoulder, for upon him rests the responsibility of placing his patient in competent surgical hands at once.

While Stemen successfully performed arthrotomy with reduction of dislocation and fracture in 1870, he did not report his cases until 1893, and then they did not seem to attract much attention, so we must consider the invention and use of the McBurney hook as the real beginning of operative reductions. In his collection of cases up to 1894, 117 in number, he says, "at least 6 cases of open operation can be referred to, in every one of which the head was either primarily or secondarily removed."³⁶ Stemen's cases are not included in his collection.

He considered "arthrotomy a grave operation, which, while it has resulted well in a few cases and has the endorsement of high surgical authority, can possibly never give a perfect functional result." ⁵⁸

It was claimed that the use of the hook was superior to open arthrotomy in that the hook could be used with less dissection and disturbance of the tissues, and that it might, in some cases, be used without entering the joint at all. Recorded experiences with the hook do not seem to establish for it any superiority over open arthrotomy. The dislocated head has been reduced many more times by the use of elevators, fingers, and forceps than has it been by the use of the hook; and there are numerous cases of perfect results after open arthrotomy. Of the 23 cases of arthrotomy and reduction in my series, secondary excision was practiced in only one instance.

So far as I have been able to find, the hook has been used 12 times, and has failed to reduce the dislocation in 6 instances.

The reported cases are as follows:

OPERATOR	No. CASES	SUCCESSFUL	FAILURE
Bull	1		1
Brown	1		1
Curtis	1		1
Dandridge	1	1	
Morton	1	1	
Porter	2	1	1
Berger	1		1
Wyeth	1		1
McBurney	3	3	
Total	12	6	6

These cases, with the exception of McBurney's first case, are recorded in my tables. Dandridge's case had recurred at the end of a month, and he says of it, "either the dislocation had recurred or it had not been reduced." ⁷

Upon this showing, I do not believe the use of the hook is entitled to the prominence that is given it in the text-books.

McBurney collected from the literature up to 1894, 117 cases of dislocation of the shoulder with fracture at the neck of the humerus. To bring the statistics up to the present time,

TABLE No. I.—RECENT DISLOCATION WITH FRACTURE AT SURGICAL NECK.

Operator and date of report	Number	Date of operation	Sex	Age	Dislocation	Treatment	Time	Hook	Effect of hook	Drainage	Result of effort to reduce by manipulation			Result classed as
											Success	Failure	Suppuration	
Bull, W. T. 1897.	1	4-12-96	M.	15	S. G.	Arthrotomy. Hook tried but failed. Head pried into place with perosteal elevator. Final case of emphysema. No seal separation. Immobilized.	48 hrs.	Yes	Failed	2 gauze drains into joint	1	1	1	Fair.
Brown, Geo. S. . . . 1897.	2		M	50	S. C.	Arthrotomy. Head wrrenched back into place. Fragments came together so well it was not necessary to wire. Hook was used but pulled out.	48 hrs.	Yes	Failed	Silk worm gut strands				Good.
Lyman, C. B. 1900.	3	6-7-97	M	42	S. C.	Arthrotomy. Slight pull with forceps on lower end of upper fragment, at right angles to body, caused reduction. Wired fracture.	7 days			?	1			Good.
	4		M	35	?	Thrust with forceps as above together with slight rotation and extension. caused reduction. Wired fracture.	Imme- diate	No		?	1	1		Good.

Curtis, B. P. 6 1906.	5	12-4-95	M	24	S. C. Arthroto-my. Bone too soft and hook pulled out. Head replaced by fingers and Head replaced by Head. Shaft was in inward rota-tion, so shaft was ro-tated inward and wired. 1 inch re-tracted from lower fragment.	Hook. 4 weeks	Yes	Failed			13 mos. Pains arm Good. without moving scapula. Constantly gaining. Inward ro-tation greater than normal. Outward ro-tation is limited. Later improving.
Dandridge, N. P. ? 1906.	6	10-11-07	M	?	S. C. Arthroto-my. Hook ap-plied. Shipped out. Again used and complete reduction seemed to have been effected. Immobilized.	18 days	Yes	Success	Tube		1 mo. X-ray shows Bad. change in Posi-tion of head. Either dislocation had re-curred or had not been reduced. Anky-losis.
Morton, T. S. K. 8 1896.	7		M	74	? Arthroto-my. Hook used. Pulled out. Head too stiff and could not be pulled out. Finger pressure completed reduc-tion. Wired frac-ture.	Imme-diate	Yes	Success	Tube		Sat up 8th day. Died suddenly. Wound clean.
Williams, H. J. . . . 8 1896.	8	12-95	M	48	? Chloroform. Reduc-tion of dislocation and adjustment of fracture. 5 weeks. Ankylosis. Violent manipulation passive motion for 7 weeks.	Imme-diate			(?)		12 weeks. Abduction Bad. 45°. For motion is nearly entirely re-covered.
Monks, G. H. . . . 9 1896.	9		M	50	S. G. Arthroto-my. Could not replace head on account of subcap-ular ankylosis. Head excised.	Imme-diate					Death on 4th day. Died. Wound clean.

TABLE NO. I.—RECENT DISLOCATION WITH FRACTURE AT SURGICAL NECK.—Continued.

Operator and date of report	Number	Date of operation	Sex	Age	Dislocation	Treatment	Time	Hook	Effect of hook	Drainage	Result of effort to reduce by manipulation			Result classed as
											Success	Failure	Suppuration	
Rovalet, A. 1901.	10	11-18-00	M	46	S. C.	Burdage. Massage 15 days, then movements. New articulation formed.	2 days				+			2½ mos. Elevation to Fair. Extension and adduction impossible. Elevation impossible. Adduction is good. Abduction easy to horizontal; extension and flexion good. 1 year improved.
Von Eiselberg. . . 1902.	11		M	39	?	Rest and massage.	8 days				+			2½ mos. Improved considerably. The best result. Improved. Good.
	12				?	Arthrotomy. Reduction. Wired fracture.	Immediate							
Koehler, Wm. . . 1901.	13	4-2-01	F	30	S. C.	Anesthesia. Extension with 10 pound weight. Counter extension upward.	Immediate							7½ mos. Movements restricted. Elevation 110°. Ext. rotation almost lost. Int. rotation good; pain in elbow on moving arm.
Schoch, Egon . . . 1900.	14	11-20-97	M	39	S. C.	Rest 14 days. Unsuccessful effort at reduction. Arthrotomy. Fracture already united. Recovery extension and external rotation.	16 days			Yes	+			7 mos. Shoulder functions perfectly normal.

Author	Year	Age	Sex	Operation	Time	Result	Remarks
Rouette	1903	35	M	S. C. Resection.	20 days	Yes	1 Can raise arm to hori- zontal and carry hand to head. Improved.
Royster, H. A.	1907	39	M	S. C. Arthroto- my. Head replaced without slightest difficulty. No wiring necessary.	4 hours	None	1 Perfect. Has as good use of shoulder as he ever had. Good.
Berger	1893	41	M	Back- ward	Reduced under chloro- form. 3 days	Yes	2 mos. Mobility satis- factory. Edema to elbow. Marked at- rophy of deltoid. Improved. Good.
Stemen, C. B.	1893	45	M	?	Arthroto- my. Reduc- tion by grasping bone with lion-jawed forceps. Treated as a compound fracture.	10 hrs. No	1 Good. Good.
		19	?	?	Similar case similarly treated only in this case which was a few years ago. we used antiseptic pre- caution and wound healed by first in- tention.	Recent	1 Good. Good.
Porter, C. B.	1894	42	M	S. C. Arthroto- my. Reduc- tion with hook. Loose fragments of bone removed.	9 days	Yes Success	6 mos. As good as be- fore operation. Good.
	1897	43	F	?	Arthroto- my. Hook un- successful. Biceps tendon divided and the head finally re- placed. Wired bone. Prosthetic opera- tion finally required resection.	1 mo. Yes Failed	1 year. Fistulous tracts persist. Can reach head with band. Improved.
Brinton, J. H.	1897	40	F	Back- ward	Excision. 3 days	Yes	2 mos. Motions of false joint returning satisfactorily. Improved.

TABLE No. I.—RECENT DISLOCATION WITH FRACTURE AT SURGICAL NECK.—Continued.

Operator and date of report	Number	Date of operation	Sex	Age	Dislocation	Treatment	Time	Hook	Effect of hook	Drainage	Result of effort to reduce by manipulation			Result	Result classed as	
											Success	Failure	Fracture			
Berger, ... 40 1896.	23		?	?	S. C.	Arthrotomy. Hooks and levers failed. Replaced by seizing tuberosities with forceps and applying force. Immobilized fracture.	10 days	Yes	Failed	Yes	+			Primary union	3 mos. Carries hand to head. Can raise to level of shoulder.	Improved.
Lane, Arbutnot 51 1903.	24		M	60	S. C.	Wired fracture. Does not mention treatment of dislocation. X-ray. Surgical neck and greater tuberosity and whole crista tuberculi majoris fractured. Anesthetized. Dislocation reduced. Fracture immobilized.	Probably lately Recent								"Uneventful progress."	Not stated.
Wohlgenuth, 19 Heinz 1900.	25		M	40	S. C.						+				Greater tuberosity has united further posteriorly on shaft. Ext. rotation not impaired. Elevation markedly impaired. Abduction 65°.	Improved
Clutton, H. H., 53 1894.	26	3-30-94	M	13	S. C.	Shock caused delay 11 days. Arthrotomy. Head replaced by direct pressure and force. Drill passed vertically downward from head into lower fragment. Ivory peg inserted. Biceps tendon had to be cut and was sutured.	11 days	No							8 mos. All movements of shoulder joint are performed perfectly. Keloid in scar.	Good.

Wyeth, J. A. 55	17/10-22-95	F	45	?	Arthroctomy. Hook inserted in 3 different places. Failed to reduce. Adhesions made reduction impossible. Excision.	Hook 2 weeks (?)	Yes	Failed	1	Death in 21 hours. Died. From history of another injury subsequently obtained and appearance of arm operation performed. Patient believes dislocation occurred 1 year before, fracture 2 weeks before.
Mason, J. M. 28	11-11-06	M	35	S. C.	Efforts to reduce failed. Arthroctomy. Head of humerus placed with periosteal elevator. Fracture wired.	6 hours	No	Gauze to point of fracture not into joint.	1	1 year. Perfect reduction. No limitation of motion in any direction. No atrophy. No pain. No loss of strength.

TABLE No. II.—OLD DISLOCATION WITH FRACTURE AT SURGICAL NECK.

Operator and date of report	Number	Date of operation	Sex	Age	Dislocation	Treatment	Time	Hook	Effect of hook	Drainage	Result of effort to reduce by manipulation			Result	Result classed as
											Success	Failure	Fracture		
Lyman, C. B. . . . 4 1902.	1		F	42	S. C.	Head displaced for one year and fibrous union of fracture had occurred. Resected and wired fracture. Attempted to treat dislocation later. Patient did not return.	1 year				1			3 years. Solid union of fracture. Quite free motion in new position beneath the coracoid.	Fair.
Porter, C. B. . . . 20 1903.		2-10-11-02	M	?	S. C.	Arthroctomy. Removal of head.	1 mo.				1			1 mo. Great improvement. Lifts right arm to horizontal. Fast gaining use of left.	Improved.
Dollinger, J. . . . 31 1902.	4	3-10-18-02	M	?	S. C.	Arthroctomy. Removal of head.	6 weeks				1			1 A case of double fracture-dislocation.	Improved.
			?	?	?	Resected head and upper fragment which had united at right angles.	Old				1			No notes.	No notes.
Abrahamoff, A. A. . . 30 1900.	5	10-14-95	M	62	S. C.	Unsuccessful attempts to reduce by manipulation under ether. Resected head.	7 weeks				1			3 1/2 mos. Paises arm 45°. Abduction and adduction free. Circumduction limited. No pain. Can lift heavy weights.	Improved.

Royster, H. A.. 39 1907.	6		F	52	?	Physician failed in ef- forts to reduce. De- cided to wait for union, then at- tempt reduction. Royster, in attempt- ing reduction by Kocher's method re- fractured. Arthro- tomy. Could not replace head. Tried to produce false joint, but fracture reunited.				Effect of operation was Bad. nil.
Linon..... 51 1898.	7		M	45	S. G.	X-ray. Head united to outer portion of humerus. Surgical interference not con- sidered. Massage and electricity to try to relieve exten- sive paralysis.	60 days			3 mos. Deltoid greatly Bad. improved. Raises arm to horizontal. Can close hand $\frac{1}{2}$.
Ricketts, B. M.. 54 1894.	8	4-94	M	49	S. C.	Failure to reduce un- der anesthesia. Re- duced in 6 weeks. Anatomic only. Anatomical and surgical necks broken and un- united. Nothing further attempted. Wound closed.	6 weeks			No notes on functional Bad. The patient's health is improved. Asks "Should head have been resected at time of attempted arthrotomy?"
Royster, H. A.. 39 1907.	9	7-19-05	?	45	S. C.	Comminuted fracture upper extremity of humerus. 6 sepa- rate fragments. Line of fracture passed surgical neck and 4 inches down shaft. Removed loose bone and packed cavity to form false joint.	6½ weeks	Yes		2 years. Can use arm Improved. for all ordinary pur- poses and without suspense of the other hand can put it in any position except wide adduction.

TABLE No. III.—RECENT DISLOCATION WITH FRACTURE AT ANATOMICAL NECK.

Operator and date of report	Number	Date of operation		Sex	Age	Dislocation	Treatment	Time	Hook	Effect of hook	Drainage	Result of effort to reduce by manipulation			Result	Result classed as
												Success	Failure	Fracture		
Curtis, B. F. 1900.	6	3-28-99	M	29	S. C.	Arthrotomy. Head entirely outside capsule. Feared necrosis if replaced and newly formed vessels destroyed. Head and large part greater tuberosity removed.	21 days								6 mos. Abduction 1/2 normal. Int. rotation nearly normal. Ext. rotation limited. Does heavy work and arm is gaining strength. Some atrophy.	Fair.
	2	9-6-99	F	21	S. G.	Arthrotomy. Anterior incision. Head not be reached. Kocher's posterior incision. Acromion divided. Extension with pressure on head in front and behind caused reduction. Bone drill driven deep into head through anterior aspect of shoulder. Left in place 20 days. Acromion wired.	24 hrs.	No		None		1			15th day. Abduction complete. Int. rotation almost normal. Ext. rotation much limited. Anteroposterior atrophy. This arm was crooked and partially paralyzed from birth.	Fair.
Gerster, A. G. . . . 1898.	9	3-10-15-97	M	47	S. G.	Removal of head.	4 weeks				Tubes		1		Death on 5th day. Reacted poorly from operation and the wound suppurated.	Died.

McBurey, Chas. 10 1896.	4 11-10-95	M	28	S. C.	Arthrotenomy. Hook. After 3rd pull, head was replaced with assistance of pres- sure on head. Sur- faces met accurately. Secured with cat gut.	1 mo.	Yes: Suc- cessful	Tube 4 days	1*	10 weeks. Good move- ment in all positions. Shoulder was not entirely except when arm is at right angles or higher.
Taylor, William 14 1901.	5	M	60	S. C.	Head displaced down- ward and inward. Also rotated. Frac- ture healed and tubercle neck. Also through great tuber- osity and 2 small pieces near lesser tu- berosity. Excision.	2 days				Lower motions of arm Fair. perfect. Limitation in upward motions. Has returned to work.
Jepson, W. 16 1900.	6 9-30-99	M	48	S. C.	Head of bone removed.	Imme- diate (?)			1	Motion of shoulder is Fair. good and function of arm completely re- materially disturb- ed.
Prewett, F. E. . . 17 1901.	7	M	27	?	Head replaced. Frac- ture healed. Placed in apposition. Three days later dressing changed as it did not retain fragments in position. Again re- duced dislocation and fracture.	24 hrs.			1	Perfect result.
Roualet, Adrien 26 1901.	8	F	23	S. C.	Unsuccessful attempt at reduction on 2nd, 9th, and 26th days. Further treatment by rest and massage.	9 days			1	6 weeks. Had recov- ered motion of eleva- tion and adduction. Very limited.
Clutton, H. H. . 47 1891.	9	F	61	S. G.	Excision of head and great tuberosity.	8 days			1	8 mos. Can put head of arm against back of head opposite shoul- der, behind back. Shoulder rather fixed in raising arm from side.

* Refracture.

TABLE NO. III.—RECENT DISLOCATION WITH FRACTURE AT ANATOMICAL NECK.—Continued.

Operator and date of report	Number	Date of operation	Sex	Age	Dislocation	Treatment.	Time	Hook	Effect of hook	Drainage	Result of effort by manipulation			Result.	Result classed as
											Success	Failure	Fracture		
McGraw, Th. . . . 48 to 1897.	10		M	45	S. G.	Fracture through anatomical neck completely detached in situ. Second fracture passing from above and in front, downward, backward, and outward below tuberosities. Excised.	4 weeks				1			1 1/2 mos. Can lift arm nearly at right angles with body.	Improved.
Delorme 24 1899.	11		?	?	?	Freed head and replaced.	28 days							Movements nearly all Fair.	
Dunham, M. V. B. 12 1895	12	1887	M	65	?	Rest and fixation for 7 weeks. Passive motion.	12 hrs.				1			Several months. Does light work not requiring an extensive range of motion. Places hand on head. Frees and dresses himself.	Improved.
Reidel 38 1900.	13	11-25-99	M	60	S. C.	Reposition effected by 2 pulls on adducted arm. Exact line of fracture not stated.	Few days				1			No notes.	No notes.

TABLE No. IV.—OLD DISLOCATION WITH FRACTURE AT ANATOMICAL NECK.

Operator and date of report	Number	Date of operation	Sex	Age	Dislocation	Treatment	Time	Hook	Effect of hook	Drainage	Result of effort to reduce by manipulation			Result classed as
											Success	Failure	Fracture	
Brigham, C. B. . . . 3 1900.	1	12-12-99	M	34	S. G.	Excision of head.	5 mos.			Tube	1	1	1	Improved.
Pilcher, L. S. . . . 5 1901.	2	1900	?	?	S. C.	Fracture already consolidated, but head was rotated and displaced. Excised head.	6 weeks							Improved.
Keen, W. W. . . . 67 1907.	3	12-27-05	M	60	S. C.	Arthroscopy. Upper end of humerus was almost entirely smooth. Hopeless to obtain union. Head completely rotated. Removed.	5 1/4 weeks			Yes	1*	(?)	1	Improved.
Maxwell, J. P. . . 15 1902.	4		M	29	S. C.	Chloroform on 2 occasions. Failure to reduce. Excision of head.	3 1/4 weeks			Yes			1	Improved.
Robert 23 1899.	5	7-18-99	M	?	S. G.	Head disengaged from fibrous tissue adhesions, etc. Replaced by Farabeuf's forceps. Fracture already united.	55 days							No notes.

TABLE NO. IV.—OLD DISLOCATION WITH FRACTURE AT ANATOMICAL NECK—Continued.

Operator and date of report	Number	Date of operation	Sex	Age	Dislocation	Treatment	Time	Hook	Effect of hook	Drainage	Result of efforts to reduce by manipulation			Result	Result classed as
											Success	Failure	Fracture		
Tansini, I. 1897.	25	6-11-97	M	?	S. G.	Difficult excision.	3 mos.				1	1		28th day "Able to use left joint."	Improved.
Bousquet 1895.	27		F	63	S. G.	Head incised in fibrous cell. Was excised by Villar.	1 mo.				*				No notes.
Dollinger, J. 1902.	31		?	?	?	Performed Linear Arthrotomy (?)	Old							No notes.	No notes.
Royster, H. A. . . . 1907.	39	6-19-07	M	20	S. C.	Arthrotomy. Healed fracture through anatomical neck. Head replaced with fingers and forceps.	2 mos.			Small	*			11 mo. Condition al- most perfect. 2 years. Entirely per- fect.	Good.
Riedel 1899.	57		...	...	...	Reports operating on 2 cases with total de- struction of head and 2 cases in which head had reunited laterally, to shut. No details.	Old Old Old Old							Not reported in such a manner that results can be classified.	No notes

* Recurred.

TABLE NO. V.—DISLOCATION WITH FRACTURE OF GREATER TUBEROSITY OF HUMERUS.

Operator and date of report	Number	Date of operation	Sex	Age	Dislocation	Treatment	Time	Hook	Effect of hook	Drainage	Result of effort to reduce by manipulation		Result as classed as
											Success	Failure	
Keen, W. W. . . . 1907.	1	2-2-07	M	56	S. G.	Immediate reduction of dislocation. 7th day, Gr. tuberosity exposed, drawn into position and nailed down. 2 wire nails used. 2 strands of No. 18 steel removed in 2 weeks. 1 in 3 weeks.	7 days			Yes			1 1 mo. and 2 days: passive motion restored. But little ankylosis.
Vaughan, Geo. T. . . 1903.	2	3-21-03	M	60	S. C.	Arthroscopy. A bony material found in glenoid cavity. Removed and found to be part of greater tuberosity. Reduction then easily effected. Unsuccessful efforts to reduce under anesthetic on 3 occasions. No further notes on treatment.	2 mos.			No	1	1	1 Great relief from pain. Improved. No notes on function.
Turner, G. I. . . . 1902.	3		M	38	?		32 days						No notes. Not stated.
	4		M	60	?	Chloroform at end of 21 weeks. All attempts to reduce failed. Marked crepitus at articulation. The humerus while being rotated. No X-ray. No further treatment permitted.	2 1/4 weeks						No notes. Not stated.

TABLE No. V.—DISLOCATION WITH FRACTURE OF GREATER TUBEROSITY OF HUMERUS.—Continued.

Operator and date of report	Number	Date of operation	Sex	Age	Dislocation	Treatment	Time	Hook	Effect of hook	Drainage	Result of effort to reduce by manipulation			Result	Result classed as
											Success	Failure	Fracture		
Wohlgemuth, Heinz, ... 1900.	5		M	66	S. C.	Immediate reduction. Function did not return. 2 years later X-ray showed dislocation reduced, but greater tuberosity located farther upward and outward than normal. X-ray showed bony growth on acromion before arm was raised to level of shoulder. Impairment of movement resulted.	2 years				1			No notes.	Not stated.
Baehr, F. 1898.	6		F	23	S. G.	Unrecognized for 1 month, then reduced (?) Came into hands of B. 3½ months. X-ray showed dislocation reduced, but greater tuberosity. No attempts at reduction.	3½ mos.				1 (?)			11 mos. All movements except bringing arm over back. This was possible but difficult.	Improved.
Dollinger, J. 1902.	7		?	?	?	Arthrotomy. Tuberosity removed. Dislocation reduced.	?				1			No notes.	Not stated.

Reclus, 1894.	58	?	?	S. C.	Unsuccessful attempts to reduce for 3 days. 8th day Heitz-Boyer apparatus caused gradual flexion of head. On 4th day gentle manipulation replaced head. Fracture reduced at same time. Immediate effort to reduce failed. On 18th day fracture greater and tuberosity. On 18th day, attempts to reduce again failed. On 28th day. Arthrothomy. Difficult reposition. 4 weeks	?	?	?	?	X-ray shows no diff. Not ankylosed in two-hu-ated mari. No notes on function.
Thomsen, H. L. 1904.	37	9	4-3-03	M	52	S. C.	Immediate effort to reduce failed. On 18th day fracture greater and tuberosity. On 18th day, attempts to reduce again failed. On 28th day. Arthrothomy. Difficult reposition. 4 weeks	?	?	Suppuration for 6 Bad. weeks. Complete ankylosis. 8 months. Abduction 36°. Rotation 15°. Detoid atrophic.
Watson 1886.	46	10		M	40	S. C.	Arthrothomy. Reduction by leverage with a lithotomy scoop. Removed the tuberosity. 7 weeks	?	?	8 mos. Very good. Improved. Some impairment.
McBurney, Chas. 1895.	52	11	10-25-94	M	?	S. C.	Incision on outer aspect of shaft. Head fixed in base of spine of scapula. Capsule freed with knife and elevator. Reduced. Fracture of greater tuberosity with bone. This struck edge of glenoid and prevented reduction. 11 days	?	?	6 weeks. Gradually considerable motion obtained. No doubt but that arm will become very useful.
Reidel 1899.	57	12	1-5-99	M	51	?	Arthrothomy. Gt. tuberosity fractured, displaced downwardly and united with shaft. Head replaced. Gt. tuberosity chiselled off. Wound left unsutured. 10 years. Arm strong. Improved.	?	?	10 years. Arm strong. Improved. Motion in joint without crepitus forward and backward 30-40 degrees. Outward 10 degrees. Rotation minimal.

I have collected since his report, 63 cases, including my own, which gives a total of 180 reported cases.

In my series the fractures have been classed as follows: Of the surgical neck 37 cases; of the anatomical neck 26 cases.

The dislocations are: Subcoracoid 31; subspinous 2; subglenoid 11; not stated 19.

Efforts to reduce by manipulation were successful in 7 cases, of which 3 recurred and 1 was of doubtful success. Failure is recorded in 37 cases, and in 19 cases it is not stated that attempts were made to reduce, but it is quite likely that in every case some effort was made to reduce before resorting to operation.

Fracture or refracture occurred in attempting reduction in 7 instances.

Taking one month as the arbitrary dividing line between recent and old cases, four tables have been prepared: recent dislocation with fracture at the surgical neck, 29 cases; old dislocation with fracture at the surgical neck, 9 cases; recent dislocation with fracture at the anatomical neck, 13 cases; old dislocation with fracture at the anatomical neck, 13 cases.

A table is also appended containing 21 cases of dislocation with fracture of the greater tuberosity.

Where the fracture has not been confined to one or the other neck, or where the line of fracture has not been clearly stated, the case has been classed under one of the above heads as accurately as possible, taking all the circumstances into consideration.

In classifying results, I have adopted the plan of Curtis, who says "In order to obtain an idea of the relative merits of reduction and resection, we must first remember that even the best functional result after resection is not to be compared to the nearly perfect shoulder-joint which can sometimes be obtained by returning the normal head to its natural articulating cavity. The result of a reduction may fall considerably below this perfection and still be as good as the best obtainable after resection. We shall therefore classify the results of reduction as good, fair, and bad, and the results of resection as fair, improved and bad."⁶

SUMMARY.

TABLE I.—RECENT DISLOCATION WITH FRACTURE AT SURGICAL NECK.
(Number of Cases 29)

TREATMENT	No.	RESULT					
		Good	Fair	Impr.	Bad	Died	Not Stated
Arthrotomy and Reduction	18	12	1	1	2	2	
Reduction	4		1	2	1		
Rest and Massage	2		1	1			
Excision	4		3			1	
Not stated	1						1
Total	29	12	6	4	3	3	1

One case is counted twice, Primary Arthrotomy with Reduction, and Secondary Excision.

TABLE II.—OLD DISLOCATION WITH FRACTURE AT SURGICAL NECK.
(Number of Cases 9)

TREATMENT	No.	RESULT					
		Good	Fair	Impr.	Bad	Died	Not Stated
Excision	5		1	3			1
Dislocation Untreated	2		1		1		
Massage and Electricity	1				1		
Riberi	1				1		
Total	9		2	3	3		1

TABLE III.—RECENT DISLOCATION WITH FRACTURE AT ANATOMICAL NECK.
(Number of Cases 13)

TREATMENT	No.	RESULT					
		Good	Fair	Impr.	Bad	Died	Not Stated
Excision	6		3	2		1	
Arthrotomy and Reduction	3	1	2				
Reduction	2	1					1
Rest and Massage	2			1	1		
Total	13	2	5	3	1	1	1

TABLE IV.—OLD DISLOCATION WITH FRACTURE AT ANATOMICAL NECK.
(Number of Cases 13)

TREATMENT	No.	RESULT					
		Good	Fair	Impr.	Bad	Died	Not Stated
Excision	6		2	3			1
Arthrotomy and Reduction	2	1					1
Linear Arthrotomy (?) Riberi	1						1
Not clearly stated	4						4
Total	13	1	2	3			7

CONDENSED SUMMARY OF ALL CASES.

(Number of Cases 63)

TREATMENT	No.	RESULT					
		Good	Fair	Impr.	Bad	Died	Not Stated
Arthrotomy Reduction	23	14	3	1	2	2	1
Excisions	21		9	10		2	
Reduction by Manipulation	6	1	1	2	1		1
Rest and Massage	5		1	2	2		
Dislocation not treated	2		1		1		
Riberi Method	2				1		1
Not stated	5						5
Total	64	15	15	15	7	4	8

(See note at foot of Table I, one case counted twice.)

From the condensed tables we find 23 cases of arthrotomy with reduction, and 14 good results, 60.8 per cent., against 21 resections with 9 fair results, 42.8 per cent. The cases classed as "good" include those where there is practically no impairment of function, and in several instances it is distinctly stated that there was perfect restoration.

Those cases of resection classed as "fair" include the best results to be obtained after resection. If no distinction were made and they were all classed as "good," there would still be a large difference in favor of arthrotomy and reduction. The results in Table No. I, early arthrotomy in dislocation with fracture at the surgical neck, show 18 operations with 12 good results, and to this should be added McBurney's first case, which is not included in this series, making 19 cases with 13 good results, 68.5 per cent. If we combine the results in Tables I and III and add McBurney's case, we have 22 recent cases of arthrotomy and reduction with 14 good results, 64 per cent. Let it be borne in mind that the tables of recent cases include everything within the first month after injury, and it will be apparent that a much higher percentage of perfect recoveries would follow immediate operation in all cases which manipulation failed to reduce.

The problem of dealing with dislocation with fracture at the anatomical neck differs in some respects from that

encountered when the fracture is at the surgical neck. In either event, delay in reducing the dislocation will make that part of the treatment more difficult. Union of fracture at the anatomical neck is much more apt to fail than when the fracture is at the surgical neck. When the fracture is at the anatomical neck and the head is entirely separated, it is cut off from all its blood supply, and while theoretically one would expect it to undergo necrosis if not at once restored, still Gray says that this must be an exceedingly rare occurrence, and Gurlt was unable to find a single authenticated case on record.⁵⁹ However, if the head remains detached from the shaft long enough for the ends of the bone to become smoothed over, as was the case with Keen's patient, the upper fragment is too small to permit of freshening as might be done with a fracture at the surgical neck, and excision will have to be practiced. For this particular reason, I do not agree with the statement of Curtis that a delay of from one to four weeks will not impair the result.⁶

If any infection is introduced in performing arthrotomy, the separated head, on account of its poor blood supply, will almost certainly undergo suppuration and necrosis, requiring secondary excision. After reduction, the head should be attached to the humerus by suture or nails.

Dislocation complicated by fracture of the greater tuberosity was considered very unusual until the X-ray came into general use, and fracture of the greater tuberosity alone was thought to be even more rare. Keen was able to present to the Philadelphia Academy of Surgery in March, 1907, 23 skiagraphs of this fracture alone or associated with other injuries. These he collected from the different hospitals of Philadelphia, and at the same meeting reported a case of dislocation with fracture of the tuberosity in which he nailed the tuberosity in place after reducing the dislocation. In going over the literature of dislocation of the shoulder with fracture of the neck of the humerus, I have collected 21 cases of dislocation with fracture of the greater tuberosity. No attempt has been made to make this collection exhaustive, and only

those cases have been recorded which have come under my notice while studying the other subject. The fractured tuberosity is often an obstacle to the reduction of what may appear to be a simple dislocation. With only the tuberosity fractured, the humeral shaft is still available as a lever in reducing the shoulder dislocation, but the tuberosity frequently becomes detached and is displaced between the head of the humerus and some of the overhanging processes of the scapula, acting as an obstacle to the return of the head of the humerus to the glenoid cavity. If left untreated and displaced, even if the dislocation is reduced, the fragment will either attach itself to the humerus in some abnormal position, thereby impairing some of the motions of the joint, or may be drawn into the capsule and become attached somewhere inside the joint cavity to interfere with the free movements of the shoulder.

The histories of the 21 cases in my series show the following treatment and results:

TREATMENT OF DISLOCATION.							
TREATMENT	No.	RESULT					
		Good	Fair	Impr.	Bad	Died	Not Stated
Reduction	2			1			1
Arthrotomy and Reduction	9		1	5	3		
Left unreduced	3						3
Reduced by Heitz-Boyer Apparatus	1						1
Not clearly stated	6					1	5
Total	21		1	6	3	1	10

TREATMENT OF FRACTURED TUBEROSITY.

Nailed in position	1
Removed	7
Untreated	4
Replaced by using Heitz-Boyer apparatus	1
Not stated	8
Total	21

Reidel states that he has operated on 15 old irreducible dislocations of the shoulder, and found 14 of them associated

with fracture and only one case uncomplicated. Of the 14 cases, 10 showed fracture of the greater tuberosity.

We see, therefore, that dislocation is often rendered irreducible by the presence of a fractured tuberosity, and that, with dislocation reduced and the fracture untreated, there is often impairment of the function of the joint. The great value of the X-ray in clearing up all injuries of the joint cannot be too strongly urged, and we should employ the rays in every case.

In early cases the dislocation should be reduced by manipulation, if this can be accomplished with gentleness, and the tuberosity should be treated by nailing into position as Keen recommends.

If this treatment should prove unsuccessful, the dislocation should be treated by arthrotomy and reduction, and the tuberosity should be nailed down in its proper position. It should be removed if it cannot be replaced. In old cases, it will be necessary to perform arthrotomy, remove exostoses and tuberosities united in abnormal positions, and then reduce the dislocation.

In those injuries where the whole upper extremity of the humerus is crushed, no general plan of treatment can be laid down, and the judgment of the operator must dictate the plan of procedure.

Excision, however, gives, oftentimes, very useful arms, and is to be preferred to allowing the cases to go on to probable ankylosis with excessive callus thrown out around badly displaced fragments.

CONCLUSIONS.

1. Every dislocation of the shoulder associated with fracture of the upper extremity of the humerus is a grave injury, and is likely to result in serious impairment of function if not promptly treated.
2. Every such injury should be subjected to X-ray examination for accuracy in diagnosis.
3. Gentleness should characterize all manipulative efforts

at reduction, and these should never be carried to the point of bruising or lacerating the tissues.

4. Excision should only be practiced when reduction by open arthrotomy has failed, or where there is extensive communication of the upper extremity of the humerus, or when, in fracture at the anatomical neck, the condition of the upper fragment does not justify a reasonable expectation of uniting.

5. After reduction, the broken greater tuberosity should be nailed into position if the case is recent, and should be removed if it causes impairment of function in an old case.

6. Failing to reduce by manipulation, immediate arthrotomy with reduction of the dislocation, followed by appropriate treatment for the fracture, has given the best results, and is the ideal method of treatment.

7. Rigid asepsis is essential in securing good results, and these operations should not be undertaken where this cannot be carried out.

NOTE.

Reidel's 14 cases are reported in such a manner that they can hardly be classified under any of my headings, so the following is abstracted from his excellent paper. He operated 15 times where reposition could not be accomplished, and found that 14 of the cases had sustained fracture at the same time. In some there was total destruction of the dislocated head; in two cases fractured head of the humerus had united laterally to the shaft; the greater tuberosity was torn off alone in 4 cases, associated with fracture of the lesser tuberosity in 6 cases. In all cases of fractured tuberosity large bony protuberances had formed owing to periosteal proliferation. He treated 7 of the 15 cases by primary resection. All terminated favorably except one, aged 70, who died from hemorrhage on 6th day. He mentions that four of nine operative repositions failed and had to be followed by secondary excision. In 5 cases operative reposition was successful, one case not complicated by fracture.⁶⁷

(Some of his work must have been a good many years ago, as one of the cases he reports was operated on in 1889, and he seems to have gotten a considerable amount of suppuration. Reference to his paper shows that he treated many of his cases by packing, and in some instances states that the wounds were not sutured. His open treatment was conducive to adhesions and ankylosis and it is not surprising that he had some very poor results. It must be remembered, too, that he was dealing with old cases, and more extensive operative work was necessary than in recent cases.)

ADDENDA.

Since the completion of this paper, I have found the reports of two cases of fracture-dislocation operated upon by Schlange. One was fracture of the surgical and one of the anatomical neck; each case was operated on within the first 24 hours and the results were good.⁶⁷

In the 5th edition of Stimson's work on fractures and dislocations, recently published, he mentions without details, two cases in which he practiced excision of the head of the humerus.⁶⁸

On Jan. 6, 1908, it was my good fortune to see, in consultation with Drs. W. P. McAdory and M. A. Copeland of this city, a case of backward dislocation of the left shoulder with fracture of the surgical neck. Dr. McAdory operated on the 5th day after the injury, reducing the dislocation and wiring the broken bone. The history of the case, together with the result will be reported by him when the patient has recovered.

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